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Superconductor/ferromagnet proximity effect in Fe/Pb/Fe trilayers

Lazar L., Westerholt K., Zabel H., Tagirov L., Goryunov Y., Garif'yanov N., Garifullin I.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

We report on measurements of structural, superconducting, and magnetic properties of trilayer and bilayer systems combined of superconducting Pb and ferromagnetic Fe. The Pb/Fe layers can be grown on Al 2O 3 with reasonably flat interfaces, there is no alloying of the components at the interface and Fe is found to be ferromagnetic down to the monolayer range. This is a favorable situation for an S/F proximity system, since it corresponds closely to the situation treated in theoretical models. We find an oscillation of the superconducting transition temperature when plotted versus the thickness of the ferromagnetic layer, which we regard as a clear indication of an unconventional, propagating superconducting pair wave function in the Pb/Fe system. We fit our results using recent theoretical model calculations and find evidence for a strongly reduced transparency of the Pb/Fe interface. We regard this as an essential feature of the proximity effect in Pb/Fe and discuss its physical origin. ©2000 The American Physical Society.